

I claim:

1. An automatic production system comprising in combination, a closed circuit or continuously extending overhead trackway, production machines flanking said trackway, a series of self propelled electrically driven work holding conveying units suspended from said trackway and free to move ^{and thereon} relative to said production machines, each of said work holding conveying units comprising in combination, a carriage or dolly having wheels adapted to ride on said overhead trackway, an electric motor mounted thereon adapted to propel said dolly along said track, means conducting electrical energy to said electric motor, said means comprising parallelly extending rails or wires insulatedly mounted and running parallel to said trackway, contacting elements insulatedly mounted on said dolly and adapted to sweep over said conducting rails, said contacting elements connected in series circuit with said electric motor and motor starting controls, a vertically extending rigid column member projecting downward from said dolly, electric motor means rotating said column member, a laterally extending platform slidably mounted on said vertical column and capable of movement up and down thereon, motor means rotating said platform about a vertical axis, means mounting a work holding fixture on said platform, means driving said work fixture and work laterally respective said overhead carriage assembly, means stopping each work holding conveying units at the same position relative to each machine thereby establishing a reference position for each machine, said means comprising a limit switch extending from said dolly and adapted to be closed when said dolly assembly is opposite said machine by a projecting element extending from said track, said limit switch being in a series circuit dolly driving electric motor and said power supply and acting to turn it off when depressed, a solenoid having a ram or pin projectable therefrom and positioned to project from said dolly against said trackway when said switch is closed, means stopping said solenoid projection and said dolly thereby positioning it respective to said station, said

means comprising a hole in said track into which said solenoid pin falls with the forward movement of said dolly assembly, a command system stopping said work conveyor assembly only at a predetermined array of said machines the selection of which is determined by the timing of said command system, said command system comprising a punched card ^{or tape} said card having a series of rows or cutouts thereon, means driving said punched card at constant speed respective to an array of rod like rider elements aligned with each of said punch card rows and riding thereon, each of said riding elements being pivotally mounted respective to a switch capable of opening and closing a circuit as said rider ends ride in and out of said punch card slots, each of said switch circuits connecting to each of said motor driven actions, said card slots being positioned to give a sequence of motions and stopping actions to each of said motors thereby directing said carriage assembly to preselected machines, and means communicating a command recorded on said punch card as an electric signal to motors situated at said machines adapted to drive components of said machines such as movable work beds, movable and adjustable clamps, said machine tool, etc., said command system thereby commanding said tool to stop work on said work, dwell periods in said command system or means automatically stopping the motion of said recorded command system while automatic functions moving or inspecting the work are performed, feedback means correcting said tool position and or said work to meet recorded command requirements, and means stopping said tool and removing said work from said machine automatically upon completion of said commanded operation, and means directing movement of said work and conveyor to the next preselected station, and so on, said trackway being arranged in a closed circuit permitting the return of conveyor unit to the beginning of the cycle without backtracking.

Unit 242
corrective measures taken then means automatically returning said work holding unit to the aisle position of said conveyor, means releasing said conveyor station holding device or stop permitting said travelling conveyor assembly to move to the next of said stations.

(2) The combination of claim 1 whereby said station identifying means comprises a light source photoelectric cell and photoelectric control unit, a relay actuating a solenoid braking said work conveying assembly when commanded at a fixed position opposite said machine tools, said photocell and light source being mounted on said work conveyor and positioned to identify markings at each work station, said markings being small reflectors mounted on the conveyor or machine at each station, and means further supporting said work holding conveyor unit at each station during the operation of the tool on the work, said means comprising an upright post or support member positioned opposite said machine at said station, means magnetically or mechanically engaging said column member or said platform thereby under command from said command system in a manner prepositioning it and the work thereon respective to said machine tool, said means comprising an electromagnet and locator projections extending therefrom against which part of said work holding conveyor unit rests, means energizing said electromagnet to attract and hold said work holding unit thereto and during the station machine operation on said work, means de-energizing said electro-magnet with the completion of the station machine operation on the work, the work prepositioning means comprising in part, a way positioned to engage a V-block on said work holding column between said platform member and the base of the machine respectively at the station, and a solenoid adapted to further hold said column.

(3) Automatic production means comprising in combination, a closed circuit overhead trackway or conveyor, a series of manufacturing machine tools, finishing machine, assembly and inspection devices positioned adjacent to and fixed relative to said trackway, each of said machines defining a station, means conveying work in process to said machines in predetermined sequence, said means comprising individual self propelled carriage, or conveyor units running on said overhead track, a rigid vertically extending column member extending therefrom, a work holding fixture mounted thereon, means stopping said column member opposite each of said stations each time such that said work holding fixture and said work is always positioned at each of said machines in the same attitude and position, means further engaging said fixture and (or) work when necessary at

5
6
7

57

each of said stations, means ^{or required} automatically positioning said work thereon rigidly respective to each of said machines and in a referenced position respective thereto (permitting machining operations thereon) means automatically starting said machine tool in motion ^{with the arrival of said conveyor unit} to ascribe a predetermined motion and action on said prepositioned work, means automatically withdrawing said work therefrom and automatically conveying it to the next of said stations after completion of the machine operation of the prior station and means automatically loading and unloading the work on said conveyor unit.

(4) Claim 3 whereby said work holding platform is movable respective to said vertical column and said column is fixed respective to said overhead track traveling carriage, said work on said platform being movable on a mount extending from said column in a direction perpendicular thereto from an extended position on one side of said column to an extended position at the other side thereof, an electric motor coupled thereto via a rack and pinion or work gear and worm to drive it laterally ^{and thereon} respective thereto, and means electrically connecting said driving electric motor to a command computer commanding action at the proper interval driving said work to and from machines situated on either side of said conveyor.

(5) The combination of claim 1 whereby said overhead carriage rides on a monorail trackway having at least four wheels riding thereon, a driving wheel rotationally mounted thereon and riding on said track, means coupling said driving wheel to an electric motor means automatically controlling the intermittent rotation of said driving wheel, to drive said carriage or truck assembly and said platform to a preselected number of said work stations, said means prepositioning said work at each of said machines prior to machining thereon comprising a mating surface therebetween said mating surfaces comprising a V-block projecting from said columnar member (and) or said station machine for sliding contact with a V-way rigidly affixed to said station or said work holding platform, adapted to mate with said V-block upon the approach of said work holding column or said platform to said station or machine, said V-way and said block being made of a hardened, wear resistant metal and being tapered at the end where they first mate prior to

complete sliding engagement, ~~and~~ ^{stopping} the relative movement of the column or platform at the station upon the full mating of said block and way and securing said conveyor assembly preposition^{ing} the work thereon respective to said station, said means comprising in part a solenoid actuated stop and holding unit between the two actuated automatically by the movement of the conveyor assembly, and an electro-magnet situated in the base of said way to attract said V-block and draw it thereto, the actuation of said electro-magnet and the prepositioning of said work initiating station machine action, means de-energizing said electro-magnet automatically upon the completion of said machine operating cycle and disengaging said holding unit therefrom, and means automatically starting said carriage upon the completion of said station operation to move the work to the next work station position relative to the machine to a second position spaced from and relative to the work.

(6) A system for automatically moving materials to and from predetermined storage areas without the need for manual attendance comprising in combination, unitized racking storage areas arranged in rows accessible to an aisle, each of said aisle accessible rows being divided into a series of unitized volumes (arranged two or more high) a unit palletized, boxed or packaged load capable of being stored in any of said volumes and means automatically placing said packaged or palletized load in each unitized volume from a remote area, and removing said packaged or palletized load from said unitized volume to a remote location, said automatic handling means comprising an overhead crane system comprising an overhead railing or tracks, an electrically powered truck or dolly running on said tracks and accessible to said aisle between said storage areas and capable of being driven along said track down said aisle, a rigid support member or column extending downward from said dolly, a platform or forks extending laterally therefrom and adapted to move up and down ^{relative to said dolly} thereon, means powering said forks up and down thereon, means rotating said forks respective to said overhead dolly and means automatically dispatching said dolly assembly to an aisle position opposite any predetermined one of said unit volumes, means commanding automatic movement of said forks to and from said predetermined unit storage volume in a predetermined path to deposit a palletized load therein and return empty to its aisle position or to engage said load therein and remove it to said aisle position and means automatically commanding the motion of said electrically powered carriage to a second position along said conveyor track and to stop thereat, deposit said

palletized unit load or, under and, automatically pick up another load.
(7) The combination of claim 6 whereby, said overhead conveyor is a mono-way rail track positioned above and opposite said tiered unit storage volumes or shelves, said radially extending platform are forks mounted on a base adapted to ride up and down on said verticle column, said forks adapted to move/laterally respective to said verticle column with or on said base and said predetermining automatic control means comprises: a presettable predetermining counters and switches in series with the circuits regulating the control of the motors driving said conveyor carriage, and platform, each of said unit volumes being identifiable by a number of rotations of said driving motors, switching means stopping the action of one counter when a preset count has been reached, said switching means automatically thereby closing a circuit starting up the next of said counters with the stopping of the previously operating counter, and to command the motor in circuit therewith to rotate a predetermined number of times and to stop when so attained, said series of motor driven actions occurring in the sequence which said predetermining counters are preset to drive said conveyor unit to an aisle position opposite said desired bay or storage volume and to lift said forks to the proper height so that they are positioned opposite the base of said bay and high enough to clear the base racking or shelf of the bay in further motion thereto, automatic means driving said forks to said bay a sufficient degree permitting the depositing therein of a palletized or boxed load thereon or the picking up of such a load therefrom, and presettable means returning said forks to a second position in said storage area, said switching means at said counter comprising a double pole double throw switch actuated with the uncounting of one counter to be thrown and to open a circuit with the motor then in operation, said switch also being coupled to a second motor and to close a circuit with said second motor starting it up, a second counter coupled to count the rotations of said second motor and to actuate a switch stopping said second motor when said preset count on said second motor has been reached, the actuation of said second counter switch closing a circuit starting up a third motor and a third counter controlled thereby, and an array of presettable counters following said third counter each coupled to the previous one to be started thereby and to control the motors driving the conveyor to opposite a storage area and to return to any position in the system and to start automatic means effecting removal or storage of a palletized load in said storage area.

8. Automatic production ⁵¹¹² ~~is~~ ^{operation} comprising in combination, a free travelling conveyor, machines and machine tools flanking, said conveyor, means conveying work thereon to said machines, said means comprising in combination an adjustable work holding jig having a bottom shaped permitting supported free movement on said conveyor, means conveying said work holding jig off said conveyor to each of said flanking machines, means detecting the presence on said conveyor of said jig at said station and initiating said action moving said jig to said machine, means securing said jig at said machine ^{in a position} ~~(predetermined automatic)~~ or said machine, permitting machining operation on the work therein, means automatically initiating operation of said machine therewith to perform a predetermined operation on the work therein, means moving said work holding jig back onto said conveyor after releasing said jig securing means automatically with the cessation of the machine operation on said work, said detecting means comprising a photoelectric electric cell positioned opposite and facing said conveyor, a light source having a projecting beam of light mounted adjacent thereto, said light beam directed so as to be interrupted by said work holding jig as it passes on said conveyor, a photoelectric control coupled to said photocell, a solenoid actuated from said photoelectric control and positioned at the side of said conveyor opposite said machine tool and adapted move said work holding jig off said conveyor to said machine an interval after the interruption of said light beam thereby.

9. A system of automatic production in accordance with the above claims whereby individual work holding jigs or units are moved to a series of machine tools, ^{and are provided for} ~~means~~ removing chips or machining wastes at each machine caused by its operation on work in said jig, said removal means comprising container means movable with said work holding units for removing said chips, said container means permitting cutting coolant and lubricating fluid pumped over the cutting area (by an outlet secured to said machine tool) to filter or pass there-thru and to pass back to the machine, said chip catching means moving with said jig away from said machine and means automatically

dumping or removing chips at a preselected location along said conveyor route.

944
In an automatic conveying system whereby a conveyor unit is guided and power driven along a trackway or guideway, station detection and selection means, said means comprising a photoelectric cell secured to said conveyor unit, a light source emitting a light beam also secured thereto to project said beam of light at a fixed attitude respectively to said conveyor unit to strike a reflector at each of said stations with the movement of said conveyor unit respective thereto and to be reflected back to said photoelectric cell, thereby energizing it, a photoelectric control amplifying said signal and coupled to a counting device or computer controlling further electrically actuated mechanical action associated with said unit, said action comprising (a) stopping said conveyor unit (b) picking up and discharging a load therefrom (c) changing the direction of motion of said unit (d) initiating ^{and controlling} action at said machine such as further clamping or securing of said work, further movement of said work at said machine, movement of said machine, etc.

11. In an automatic storage system comprising in combination a system of storage racks or shelves stacked one on top of the other in an area defined by rows and aisles, reference positions on said shelves each of which is identifiable by an X, a Y and a Z coordinate in the system; an overhead conveyor system comprising a trackway or rails supported above said rack, a crane bridge having wheels at each end riding on said rails, said crane bridge having a longitudinal trackway a carriage riding thereon an electric motor driving said carriage longitudinally along said bridge, a rigid column extending downward from said carriage, to a point above the floor, an electric motor driving said crane bridge along said overhead trackway, a rigid member extending laterally from said rigid column capable of motion relative to said column, said motion being up and down and or rotational or radial respectively to said carriage, said laterally ex-

17 tending member being ⁹⁰ platform or said forks being slidably mounted on said column to ascribe an up and down motion thereon, motor means driving said forks up and down thereon, and means directing and automatic, presetting and predetermining means directing motion of said bridge from a first position in said system to a position above a desired area on said racking, remote presetting means directing motion of said carriage on said crane bridge to a position so that said verticle column extending therefrom is opposite said desired racking area, remote presetting means directing motion of said forks to a position opposite said desired area of access, and automatic means directing said forks to ascribe a motion therefrom to deposit a ballitized load on said shelving or remove one therefrom, said remotely setting presetting and predetermining means comprising in combination presetable predetermining counters mounted on said conveyor assembly, connected in series circuit with the afordescribed servo electric motors driving said bridge carriage, forks and column and means detecting the movement thereof relative to said rack.

18 11. The combination of claim 9 whereby said storage racking has a vertically and horizontally extending laticework facing the aisle such as the cross bars forming storage unit volumes or shelving and wall edging facing said aisle, and means are provided detecting passage of said conveyor unit past each of said storage volumes, said detection means comprising a switch mounted at the end of said forks, said switch having an arm universally pivotally mounted thereon and projecting forward therefrom below the upper surface thereof, means automatically moving said forks opposite said racking so that said switch arm may strike each of said lattice cross-bars with the passage thereby of said conveying assembly and forks, the passage of said switch arm past one of said horizontal or verticle cross-bars from either direction deflecting said switch arm sufficiently to close the switch, said switch being in series circuit with a predetermining counting system which is coupled to command action of the motors driving said conveyor unit and forks, motor means automatically driving said work-holding platform with the stepping of said verticle column to said.

12. An automatic production system comprising a closed circuit or continuously extending overhead trackway, production machines flanking said trackway, a series of self propelled electrically driven unit work holding conveying units suspended from said trackway and free to move relative to said machines thereon, each of said work holding units comprising in combination a carriage or dolly having wheels free to rotate thereon and to ride on said overhead trackway, an electric motor secured thereto and adapted, when in operation, to propel said dolly along said track, means conducting electrical energy to said electric motor, said means comprising parallelly extending bus bars or wires extending parallel to said trackway, contacting elements insulatedly mounted on said dolly assembly sweeping said conducting wires said contacting elements connected in series circuit with said electric motor and motor starting controls, a vertically extending rigid columnar member extending downward from said dolly electric motor means rotating said column, a laterally extending platform slidably mounted on said verticle column and capable of movement up and down thereon, motor means moving said platform up and down thereon, motor means rotating said platform about a verticle axis, a work holding fixture situated on said platform, means driving said work fixture or work laterally respective to said column, (means automatically clamping and unclamping said work in said fixture, means stopping each work conveying assembly repetitively at the same position relative to each machine, means establishing a reference position for each machine, said stopping means comprising a limit switch extending from said dolly, a first projection or pin extending from said overhead track and positioned to actuate said limit switch, said limit switch being in a circuit with said dolly driving motor and acting to turn it off when depressed, a second limit switch, a pin positioned on said track to actuate said second limit switch in interval after the actuation of said first limit switch, a solenoid urging movement of a pin projecting from said dolly to engage in a hole on said railing or track, the action of said switch, stopping said motor also actuating said solenoid ^{to engage said hole} so that said dolly is stopped ^{and thereby} and positioned opposite said machine, motor means automatically driving said work holding platform (with the stopping of said verticle column) to said machine, a first limit switch positioned to project beyond the end of said work holding platform, said limit switch connected in circuit with said work holding platform motor and a power supply and adapted to open said circuit stopping said motor upon contact with the end of said machine base or a projection therefrom, said limit

switch being mounted to be completely retractable into said work platform to permit flush contact of the end of said platform with said machine tool end wall, the arm of a second limit switch projecting from the bottom of said platform extending from said carrier vertical column, and completely retractable therein, a base extending horizontally from said machine tool end wall, the depression of said first limit switch closing a circuit with a motor driving the conveyor platform vertically and thereby driving said platform downward against said machine base or platform, said second limit switch being closed thereby stopping said motor after it has driven said surfaces snugly together, further means securing said conveyor platform at said machine platform, said securing means comprising an electromagnet embedded in said machine platform to magnetically engage said platform and hold it secure during operations on the work therein, and (or) electrically operated power clamps physically engaging and holding said conveyor platform, means initiating said further engaging action, said means comprising a limit switch mounted at said machine platform or base and having a depressible arm extending above the surface thereof which is adapted to close a circuit with said electrical securing means and thereby actuate said power clamps and (or) said electro magnet, the depressing of said machine base mounted switch by movement of said conveyor platform thereto also effecting closing of a circuit having motors driving the mechanism of said machine and a predetermined command computer commanding action of said machine on said work held by said conveyor unit, means associated with said machine starting up said work conveyor unit motor driving said conveyor platform and said work to clear said machine platform upward thereoff and back to said aisle position to the next of said machines followed by automatic release of said holding means, said platform release and said starting means comprising a solenoid actuated ram mounted on said machine platform positioned normally retracted in a cavity therein below the surface of said platform and opposite a compressible limit pressure actuable switch mounted in a cavity on said conveyor platform and actuable to close a circuit with said withdrawing motor, the completion of said machine operation and the withdrawal of said machine tool from said work act causing a circuit to close with said solenoid, thereby actuating it to project from its mounting position against said conveyor platform situated switch thereby closing a circuit with said motor effecting withdrawal of said conveyor platform to said aisle position, means stopping said work holding platform after it is withdrawn and simultaneously starting up the motor driving said conveyor along said trackway to the

next of said machines, said pl^g stopping means comprising a limit switch mounted on said conveyor assembly to be actuated with the return motion of said work or said work conveyor and thereby opening a circuit with and stopping said driving motor.

13. Automatic production means comprising in combination, a work conveying system having a continually moving conveyor line, production machines flanking said conveyor line, an array of individual work holding fixtures or carriers being conveyed thereby past said machines, means moving each of said work holding fixtures off said conveyor to a preselected number of said machines in a predetermined sequence, each of said machines having a tool or fixture capable of performing an operation on work held in said fixture, each of said machines defining a work station, means at each of said stations automatically clamping or holding said work fixture in a prepositioned position relative to said machine, said positioning and holding means utilizing the shape of said carrier mating with a similarly shaped base of said machine or with projections extending therefrom and means further forcing said jig thereagainst so that said jig and the work held therein is always referenced relative to the machine or machine tool and that similar pieces of said work held in similarly shaped jigs will be referenced similarly thereto permitting said machine tool to perform in a predetermined manner thereon without further referencing, and similarly permitting inspection devices to be utilized without further inference actions, said work holding jig having automatic clamping means holding said work and having adjustable means permitting a variety of products to be held therein when so adjusted, a photoelectric cell mounted on said fixture positioned to scan the wall of said conveyor guideway, reflective markers positioned on said guideway opposite each of said machines to be swept or scanned by said photocell, a light source adjacent thereto mounted on said jig projecting a beam against said conveyor guideway which is reflectable back into said photocell thereby energizing it, said photocell in circuit with an amplifier and a relay sending a current pulse each time it is energized to a counting mechanism, means presetting said counting mechanism (which is so presettable) to close a circuit with a solenoid with the receipt of each of said current pulses or every predetermined number or any order of said pulses, a limit switch at each machine bed said solenoid controlling a ram mechanism mounted on said jig pushing said jig off said conveyor, a limit switch at each machine bed mounted therein and projecting to

be actuated by the movement of said work holding jig off said conveyerway there-
to, and to close a circuit thereby with machine mounted machine clamps or hold-
ing means engaging said jig which preposition the sides and base thereof
when each time thereat at the same attitude and to a degree permitting precise
referencing of the jig and the work therein respective to the at rest position
of said tool so that the latter may be commanded to operate thereon without
further referencing and to a degree commensurate with the precision required
for machining tolerances, electrical coupling means between the work jig and
the machine whereby said coupling is effected when the two are in said refer-
enced position, a command computer mounted in said jig commanding machining
action thereon and commanding removal of said tool and release of said jig
from said station when said machine work is finished, servo motor driven
probes and inspection devices commanded thereby to perform in a predetermined
manner by said command computer and inspect or measure said work, feedback
mechanisms and computers in circuit with said tool driving motors and capable
of commanding further action of said tool ^{on said work} proportional to the difference
in the signal of said preset command computer to said inspection devices and
the signal obtained by actual measurement of the work until said preset measur-
ment is obtained, and means initiated by said command computer moving said
jig back on to said conveyer upon the completion of said station work thereon.

7. The combination of the applicable claims of this invention whereby said
overhead trackway comprises a bi-rail track mounted above said machines or said
racking and means are provided stopping said laterally extending platform in its
return therefrom, said means comprising a ^{cross} ~~cross~~ bridge extending across said
bi-rail track, wheels mounted on the ends thereof riding on said tracks, power
means driving said cross bridge along said track, said vertical columnar
member being suspended from a carriage riding on said cross bridge and driven
thereon by an electric motor, a projection extending from said cross bridge
positioned and adapted to mate with a limit switch extending from said carriage,
said limit switch being a double pole double throw switch adapted when actuated
by said projection to open a circuit with said carriage motor and (or) initiate
electrical braking means, and at the same time to start up the motor driving
said cross bridge along said overhead tracks, said columnar member having at
least two sections, a lower and an upper section assembled to telescope together,
the laterally extending platform or forks being mounted on the lower section
of column and means driving said lower section and platform up and down respect-
ive to said upper section.

16
In an automatic system moving products to and from a storage area, an individually powered conveyor unit, trackway means guiding said unit under command to said storage area or to any area in said system, a presettable predetermining command device mounted on said conveyor unit commanding-controlling the movement of said unit to and from said area by starting and stopping motors driving said unit, electrical means presetting said command device, said electrical means comprising a dial switch/generating pulses of electricity, an electromagnetic relay actuated by said dialed pulses to actuate and preset said command device, mounted on said conveyor unit, and means remotely preactuating said command device, said means comprising (a) ~~or bank of preselection switches~~ automatically stopping said conveyor unit at a predetermined position on said trackway, electrical contact elements projecting from said conveyor unit and making contact with electrical elements positioned thereopposite when so stopped, and mounted on a rigid support, wires extending therefrom to said dial switch located remotely, a power supply in circuit therewith, said unit mounted electrical contact elements extending to said electromagnetic relay, or (b) said relay receiving electrical energy and being actuated when a circuit is closed with a power supply by a relay actuated by radio receiving apparatus as mounted on said conveyor unit and actuated by a remotely sent signals initiated by said preselection switches which actuate radio sending apparatus.

JHX

16. The combination of claim 12 whereby said fork mounted switch is replaced by a photoelectric cell, a light source adapted to move up and down with said forks, a photoelectric control comprising an amplifier in circuit therewith, a relay adapted to be energized by when said photocell is energized in circuit with said counting means, said photocell and said amplifying circuit being of such a sensitivity to be energized by the reflection of said light emitted by said light source off the structure of said storage rack or off the box, bin or product therein.

17. An automatic production device comprising in combination, parallelly extending overhead tracks supported above a floorway and production machines therebelow, a rigid crossbridge structure having wheels riding and guided on said tracks, a first electric motor driving said crossbridge along said parallel trackway, longitudinal guides, tracks or surfaces on said crossbridge, and a carriage adapted to move longitudinally on said crossbridge, a second electric motor coupled to drive said carriage, said carriage having a columnar member or rigid frame extending downward therefrom, work holding means secured to said columnar member, production machines positioned below said overhead trackway each of said machines defining a station, means starting said first motor to drive said crossbridge to a position where it passes over said station or opposite thereto, means automatically stopping said first motor and said crossbridge so that the latter is in line with said station, means automatically starting said second motor and moving said columnar member from a first position along said crossbridge to a second position at said machine, switch means automatically stopping said second motor with the arrival of said column held work fixture at said machine, switch means actuated by the movement thereof to said machine starting said machine to operate on the work held thereon, switch means associated with said work holding means and the movement of said machine starting said second motor with the completion of the work by said machine thereon and driving said carriage-column assembly back along said track to said first position again, a projection extending from said crossbridge at said first position to actuate a switch on said carriage stopping said second motor with the arrival at said first position and starting said first motor to drive said crossbridge further along said overhead trackway.

15. Automatic production means comprising in combination a continually moving belt type conveyor, a series of unit work carrying fixtures the base of each being shaped permitting travel thereon, adjustable and or automatic means securing work in each of said fixtures, power operated production machines positioned adjacent to said conveyor, each of said machines defining a work station, means at each station moving said fixtures one at a time off said conveyor to a predetermined position at said machine, means further clamping or holding said fixture thereat in a manner such that it (and each of said fixtures) will always be held thereby in a position such that any point on said fixture will always be at the same location respective to the machine thereby referencing or zeroing the fixture respective to the machine and tool to a degree permitting precision machining operations thereon, on work held thereby, means holding the work thereby such that it is always (and successive pieces of similar work) referenced respective to said fixture, means associated with said further machine clamping means starting said machine to operate in a preset or predetermined manner on the work held in said fixture, and means associated with the completion of the work by said machine thereon initiating action of means conveying or pushing said fixture and said work back on said conveyor,

16. In an automatic production system, a production area or floorway, an array of power operated production machines thereon, each defining a station, an overhead trackway supported thereabove, an array of individual work carriers riding on said trackway ^{24/2} ~~passing~~ in close proximity of each of said machines, said carriers comprising a trackway riding carriage, a columnar member extending downward therefrom and secured thereto, a work holding fixture, means mounting said fixture laterally and ~~relative~~ ^{relative} to said column, each of said machine tools being mounted on a base projecting upward from said floor, means rigidly securing work in said work holding fixture at a loading section along said trackway, an electric motor mounted on and driving said carriage along said trackway, means stopping each of said conveyor carriers opposite each of said machines, means positioning and holding said laterally mounted work holding fixture securely respective to each station machine by automatic means engaging said fixture from said machine bed or engaging said bed from

from said column or fixture, the arrival of said conveyor carrier assembly thereat initiating said further engaging or holding means, said action further closing a circuit with electrical means initiating action of said machine on the work held therein, means automatically disengaging said conveyor assembly therefrom upon the completion of said work thereon, said means also starting the means driving said assembly along said overhead track towards the next of said stations.

20. The combination of claim 19 whereby said work holding fixture secured to said vertical column is provided with means automatically engaging and disengaging work held thereby, and means are provided disengaging the work held thereby at said machine base automatically with the arrival of said fixture thereat, said disengaging means accompanied by withdrawal of said fixture therefrom, and means further engaging said work at said machine automatically initiated with its position thereat, said initiating means also initiating performance operation of the machine on the work held thereby, and means automatically engaging the work with the completion of the machine operation thereon by said work holding fixture in the attitude it was released, means automatically moving said conveyor assembly to the next of said stations with the completion of said automatic reengagement thereof.

21. A presetable, predetermining command computer capable of opening and closing circuits in a predetermined sequence and for predetermined time intervals, said computer comprising a rigid base or mount, an electric motor mounted thereon, means controlling said motor to rotate at a constant speed, a punched card or tape having longitudinal slots cut therein, a driving mechanism capable of moving said card or tape relative to said base, said motor being coupled to said driving mechanism, electrical switches mounted rigidly on said base or a projection thereof, each of said switches having an arm pivotally mounted thereon, the end of each arm normally riding on the surface of the tape or card as it is driven therethru, each arm being positioned to be swept by a narrow band thereof running parallel to the direction of said tape or card and in line with said slots, and spring loaded against the surface of the tape or card, said arms riding in and out of said slots with the move-

ment of said slots respective to as said card or tape is driven, the movement of the end of said arm in and out of said slots closing and opening the switch to which it is secured and thereby closing and opening a circuit therewith.

²³22. Automatic production means comprising in combination, an array of production machines, said machines positioned adjacent a conveyor capable of conveying work in process to said machines, said conveyor comprising an overhead trackway, a carrier riding thereon in a fixed attitude respective to said track, electric motor means driving said carrier past each of said machines, a rigid verticle member extending downward from said carrier, said verticle member being secured thereto so that it is vertically rigid, means mounting work on said verticle member, said means comprising a work holding fixture or mount extending laterally from said verticle column, means mounting work in process thereon, means stopping each of said carriers at each of said machines in a position so that said work held in said fixture is referenced respectively to said machine to a degree permitting the operation of said machine in a predetermined manner to the degree of accuracy required by said operation of said machine, and means automatically moving said carrier and said work to the next of said stations with the completion of the operation of said machine thereon.

²⁴23. The combination of claim 22 whereby the means stopping each of said carriers at each of said machines is initiated by the motion of said carrier relative to said machine, said stopping means comprises a switch on said carriage actuated by a projection on said trackway (or a photoelectric cell adapted to actuate a switch by said cell detecting variations in light projecting thereon at said station, said cell facing said track and actuating said switch by a change in light intensity of light reflecting of light thereoff or initiated by light passing thru a hole in said track at said station as contrasted to the light reflected thereoff), said machine starting means is also initiated by the motion of the conveyor-carrier assembly respective thereto, said means comprising a limit switch projecting from said machine to be closed by said conveyor unit, and said means starting said carrier-conveyor unit to move on to the next of said stations comprises a limit switch mounted thereon in series with a solenoid actuating a switch starting up said carrier electric motor driving means, said conveyor mounted limit switch being actuated by motion of said machine or a solenoid projecting therefrom and thereopposite,

and actuated to close said limit switch, with the completion of said machine operation.

24. In conveying apparatus having a support, a prime mover driving said support, a rigid columnar member extending vertically therefrom, a rigid, laterally extending materials handling device (such as forks, a platform, a grab, etc.) mounted on said vertical columnar member, means automatically moving said laterally extending materials handling device up and down relative to said support, a mechanism capable of detecting variations in the reflection of light off a surface or surfaces opposite said laterally extending handling device in its vertical motion, said mechanism comprising a photosensitive or photoelectric cell mounted to move up and down with said lateral handling device, amplifying means, a relay in circuit therewith and adapted to be closed by a predetermined change in intensity of light entering said photoelectric cell, said photoelectric cell being positioned (and protected by lateral blinding to prevent lateral light from actuating or energizing it) to scan in front of said laterally extending handling device, said relay being connected to further actuate an electrical or electro-mechanical mechanism with said aforementioned change in light intensity.

25. The combination of claim 24 whereby said overhead track comprises a bi-rail trackway, said carrier rides on a crossbridge member which rides on said bi-rail track, said station stopping means stops said crossbridge opposite each of said machines, said crossbridge stopping is accompanied by movement of said vertical column member to said machine, the motion thereto is stopped by a limit switch mounted thereon and actuated by contact therewith with said machine, the motion of said work holding fixture relative to said machine also initiating starting up said machine to perform on the work held in said fixture in a predetermined manner, means automatically removing said vertical column and fixture from said machine with the completion of said machine operation and automatically moving said crossbridge along said trackway to the next of said stations.

27.
 A tape magazine in computer and the like having a punched tape running from a first reel to a second reel comprising in combination, an oblong casing having parallel faces, said reels being rotationally mounted therebetween and spaced apart so that their axes of rotation are essentially parallel, an opening along the edge of said casing extending across each of said parallel faces and said edge, and positioned between said reels, means driving said tape from one reel onto the other, means mounting on a base said casing so that said opening is opposite a bank of switches mounted thereoff on a mount, feeler elements extending from said switches to be positioned over said tape when so mounted and to drop in and out of outcuts in said tape, means guiding said tape across said opening and and further supporting said tape thereacross so that it will not deflect when said feeler elements ride thereover.

28.
 A tape magazine for use in computers and the like and tape recorders comprising in combination, an oblong casing having parallel faces, a first reel and a second reel mounted therebetween and rotationally drivable, means driving one of said reels to remove the tape from the other of said reels so as to wind up thereon, said tape having a magnetic recording material thereon, an opening in said casing between said reels, means guiding said tape across said opening, said opening extending across the edge of said casing and into both faces sufficiently to permit said reel to be mounted on a base member with part of a magnetic pickup device projecting therethru, extending only across said edge and contacting-part positioned so that a magnetic pickup head contacts or is in close proximity of said tape, means guiding said tape across said opening, said magnetic pickup head which is opposite said casing being spring loaded thereagainst so that it may be moved laterally relative thereto allowing said casing to be mounted and held adjacent thereto and means coupling a driving shaft to said magazine to drive one of said reels and wind up the tape from the other of said reels thereon.

Approved
 by applicant
 5/11/54
 Claim No. 17 Deleted
 as not necessary
 for this claim at time
 of filing
 Done. [Signature]

HX

Jerome Demeler

6-2-54

add to

add to